

CLAIMS

What Is Claimed Is:

1. A transfer case comprising:

an input shaft;

first and second output shafts;

a range unit driven by said input shaft and having an output component driven at a reduced speed relative to said input shaft;

a dog clutch operable in a first range position to couple said input shaft to said first output shaft for establishing a high-range drive connection, said dog clutch is further operable in a second range position to couple said output component of said range unit to said first output shaft for establishing a low-range drive connection;

a mode clutch including a clutch pack operably disposed between said first and second output shafts and a pressure plate moveable between a first mode position whereat a minimum clutch engagement force is exerted on said clutch pack and a second mode position whereat a maximum clutch engagement force is exerted on said clutch pack;

an actuation mechanism for coordinating movement of said dog clutch and said pressure plate, said actuation mechanism including a geartrain having an input gear and an output gear, a motor driving said input gear, a range actuator assembly driven by said output gear for moving said dog clutch between its first and second range positions, and a mode actuator assembly driven by said output gear for moving said pressure plate between its first and second mode positions, said output gear being rotatable through a

first range of travel for causing said range actuator assembly to move said dog clutch between its first and second range positions while said mode actuator assembly maintains said pressure plate in its first mode position, a second range of travel for causing said range actuator assembly to maintain said dog clutch in its first range position while said mode actuator assembly moves said pressure plate between its first and second mode positions, and a third range of travel for causing said range actuator assembly to maintain said dog clutch in its second range position while said mode actuator assembly moves said pressure plate between its first and second mode positions; and

a control system for controlling actuation of said motor.

2. The transfer case of Claim 1 wherein said first range of rotary travel of said output gear equals about 180° and said second and third ranges of rotary travel of said output gear each equal about 90° .

3. The transfer case of Claim 1 wherein said geartrain includes a first gearset having said input gear driven by said motor and a first transfer gear driven by said input gear for rotation about a first axis, and a second gearset having a second transfer gear driven by said first transfer gear for rotation about said first axis and which drives said output gear for rotation about a second axis.

4. The transfer case of Claim 1 wherein said range actuator assembly comprises:

- a driveshaft coupled for rotation with said output gear;
- a range cam coupled for rotation with said driveshaft;
- a shift fork coupled to said dog clutch; and
- a mechanism interconnecting said shift fork to said range cam which is operable to convert rotary movement of said range cam into axial movement of said shift fork for moving said dog clutch between its first and second range positions.

5. The transfer case of Claim 4 wherein said mechanism includes a follower secured to said shift fork which extends into a groove formed in said range cam, said groove including a high-range dwell segment, a low-range dwell segment, and a shift segment interconnecting said high-range and low-range dwell segments, said shift segment is configured to cause axial movement of said dog clutch between its first and second range positions during rotation of said driveshaft caused by rotation of said output gear through its first range of rotary travel, said high-range dwell segment is configured to maintain said dog clutch in its first range position during rotation of said driveshaft caused by rotation of said output gear through its second range of rotary travel, and said low-range dwell segment is configured to maintain said dog clutch in its second range position during rotation of said driveshaft caused by rotation of said output gear through its third range of rotary travel.

6. The transfer case of Claim 1 wherein said mode actuator assembly comprises:

a control gear driven by said output gear for rotation about a third axis;

a cam member having a pair of first cam surfaces, a pair of second cam surfaces, and an anti-rotation lug;

a pair of rollers mounted to said control gear and adapted to engage either of said pairs of first and second cam surfaces; and

a thrust member for causing axial movement of said pressure plate between its first and second mode positions in response to axial movement of said cam member between a retracted position and an extended position relative to said control gear.

7. The transfer case of Claim 6 wherein rotation of said output gear within its first range of rotary travel causes corresponding rotation of said control gear through a first range of rotary travel, and wherein rotation of said control gear through its first range of rotary travel causes concurrent rotary movement of said cam member while said cam member is maintained in its retracted position.

8. The transfer case of Claim 7 wherein rotation of said output gear within its second range of rotary travel causes corresponding rotation of said control gear through a second range of rotary travel, and wherein rotation of said control gear through its second range of rotary travel causes said anti-rotation lug on said cam member to engage a first anti-rotation stop such that said control gear rotates relative to said cam member, whereby such relative rotation causes said rollers to ride on said pair of first cam surfaces and forcibly move said cam member between its retracted and extended positions so as to cause corresponding movement of said pressure plate.

9. The transfer case of Claim 8 wherein rotation of said output gear within its third range of rotary travel causes corresponding rotation of said control gear through a third range of rotary travel, and wherein rotation of said control gear through its third range of rotary travel causes said anti-rotation lug on said cam member to engage a second anti-rotation stop such that said control gear rotates relative to said cam member, whereby such relative rotation causes said rollers to ride on said pair of second cam surfaces and axially move said cam member between its retracted and extended positions so as to cause corresponding movement of said pressure plate.

10. The transfer case of Claim 6 wherein each of said control gear, said cam member and said thrust member coaxially surround said first output shaft.

11. The transfer case of Claim 6 further comprising a transfer unit drivingly connected to said second output shaft, and wherein said mode clutch includes a hub coupled to said transfer unit and a drum coupled to said first output shaft, and wherein said clutch pack is operably installed between said hub and said drum.

12. The transfer case of Claim 1 further comprising a synchronizer for causing speed synchronization between said input shaft and said first output shaft in response to movement of said dog clutch to its first range position.

13. A transfer case comprising:

an input shaft;

first and second output shafts;

a differential having an input member, a first output member coupled to said first output shaft, and a second output member coupled to said second output shaft;

a range unit driven by said input shaft and having an output component driven at a reduced speed relative to said input shaft;

a dog clutch operable in a first range position to couple said input shaft to said input member of said differential for establishing a high-range drive connection, said dog clutch is further operable in a second range position to couple said output component of said range unit to said input member of said differential for establishing a low-range drive connection;

a mode clutch including a clutch pack operably disposed between any two members of said differential, and a pressure plate that is moveable between a first mode position whereat a minimum clutch engagement force is exerted on said clutch pack and a second mode position whereat a maximum clutch engagement force is exerted on said clutch pack;

an actuation mechanism for coordinating movement of said dog clutch and said pressure plate, said actuation mechanism including a geartrain having an input gear and an output gear, a motor driving said input gear, a range actuator assembly driven by said output gear for moving said dog clutch between its first and second range positions, and a mode actuator assembly driven by said output gear for moving said pressure plate

between its first and second mode positions, said output gear being rotatable through a first range of travel for causing said range actuator assembly to move said dog clutch between its first and second range positions while said mode actuator assembly maintains said pressure plate in its first mode position, a second range of travel for causing said range actuator assembly to maintain said dog clutch in its first range position while said mode actuator assembly moves said pressure plate between its first and second mode positions, and a third range of travel for causing said range actuator assembly to maintain said dog clutch in its second range position while said mode actuator assembly moves said pressure plate between its first and second mode positions; and

a control system for controlling actuation of said motor.

14. The transfer case of Claim 13 wherein said first range of rotary travel of said output gear equals about 180° and said second and third ranges of rotary travel of said output gear each equal about 90°.

15. The transfer case of Claim 13 wherein said geartrain includes a first gearset having said input gear driven by said motor and a first transfer gear driven by said input gear for rotation about a first axis, and a second gearset having a second transfer gear driven by said first transfer gear for rotation about said first axis and which drives said output gear for rotation about a second axis.

16. The transfer case of Claim 13 wherein said range actuator assembly comprises:

a driveshaft coupled for rotation with said output gear;

a range cam coupled for rotation with said driveshaft;

a shift fork coupled to said dog clutch; and

a mechanism interconnecting said shift fork to said range cam which is operable to convert rotary movement of said range cam into axial movement of said shift fork for moving said dog clutch between its first and second range positions.

17. The transfer case of Claim 16 wherein said mechanism includes a follower secured to said shift fork which extends into a groove formed in said range cam, said groove including a high-range dwell segment, a low-range dwell segment, and a shift segment interconnecting said high-range and low-range dwell segments, said shift segment is configured to cause axial movement of said dog clutch between its first and second range positions during rotation of said driveshaft caused by rotation of said output gear through its first range of rotary travel, said high-range dwell segment is configured to maintain said dog clutch in its first range position during rotation of said driveshaft caused by rotation of said output gear through its second range of rotary travel, and said low-range dwell segment is configured to maintain said dog clutch in its second range position during rotation of said driveshaft caused by rotation of said output gear through its third range of rotary travel.

18. The transfer case of Claim 13 wherein said mode actuator assembly comprises:

a control gear driven by said output gear for rotation about a third axis;

a cam member having a pair of first cam surfaces, a pair of second cam surfaces, and an anti-rotation lug;

a pair of rollers mounted to said control gear and adapted to engage either pair of said first and second cam surfaces; and

a thrust member for causing axial movement of said pressure plate between its first and second mode positions in response to axial movement of said cam member between a retracted position and an extended position relative to said control gear.

19. The transfer case of Claim 18 wherein rotation of said output gear within its first range of rotary travel causes corresponding rotation of said control gear through a first range of rotary travel, and wherein rotation of said control gear through its first range of rotary travel causes concurrent rotary movement of said cam member while said cam member is maintained in its retracted position.

20. The transfer case of Claim 7 wherein rotation of said output gear within its second range of rotary travel causes corresponding rotation of said control gear through a second range of rotary travel, and wherein rotation of said control gear through its second range of rotary travel causes said anti-rotation lug on said cam member to engage a first stop such that said control gear rotates relative to said cam member, whereby such relative rotation causes said rollers to ride on said pair of first cam surfaces and move said cam member between its retracted and extended positions so as to cause corresponding movement of said pressure plate.

21. The transfer case of Claim 20 wherein rotation of said output gear within its third range of rotary travel causes corresponding rotation of said control gear through a third range of rotary travel, and wherein rotation of said control gear through its third range of rotary travel causes said anti-rotation lug to engage a second stop such that said control gear rotates relative to said cam member, whereby such relative rotation causes said rollers to ride on said pair of second cam surfaces and move said cam member between its retracted and extended positions so as to cause corresponding movement of said pressure plate.

22. The transfer case of Claim 18 wherein each of said control gear, said cam member and said thrust member coaxially surround said first output shaft.

23. The transfer case of Claim 18 further comprising a transfer unit drivingly connected between said second output member of said differential and said second output shaft, wherein said mode clutch includes a hub coupled to said transfer unit and a drum coupled to said first output shaft, and wherein said clutch pack is operably installed between said hub and said drum.

24. The transfer case of Claim 13 further comprising a synchronizer for causing speed synchronization between said input shaft and said input member of said differential in response to movement of said dog clutch to its first range position.